sudsing in our waterways, the industry produced a new surfactant—*linear alkylate sulphonate* or *LAS*. LAS decomposes readily under bacterial action, and has been used since 1966 in all detergents sold in Canada.

Detergents made with LAS are often labelled "biodegradable", but this can be misleading. Although the *surfactant* is biodegradable, the *phosphate builder* is not; and it is the phosphate which causes the problem. The builder commonly used is a sodium salt called *sodium tripolyphosphate* or *STP*.

Wanted: a substitute

To slow the process of eutrophication, we must either stop using detergents or drastically limit the amount of phosphate they contain. As soon as possible, indeed, we should eliminate detergent phosphates altogether. Restricting and eventually eliminating the use of detergent phosphates is, however, only the first step in the gradual elimination of phosphates from *all* sources.

To maintain the cleaning effectiveness of the detergents, the phosphates will have to be replaced by an equally effective biodegradable substitute.

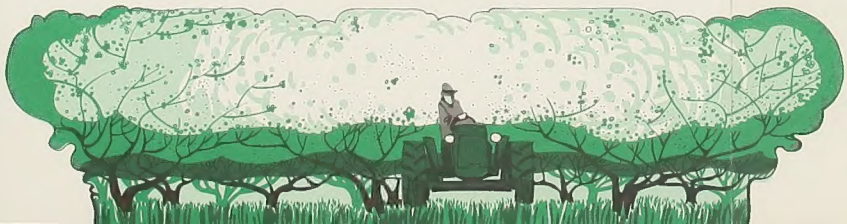
The most promising substitute to date is a by-product of the plastics industry, *sodium nitrilotriacetate* or *NTA*. Although NTA does not contain phosphates, it does contain a small amount of nitrogen. In Sweden, one detergent manufacturer has replaced 70 percent of the phosphates in some products with NTA. The products involved account for approximately 15 percent of Sweden's total detergent sales. Over the 1968-70 period during which NTA has been in use, no undesirable environmental effects have appeared.

Tests, early in 1970, on a variety of washing and cleaning products by scientists of the Department of Energy, Mines and Resources showed a range of phosphate content of from less than one percent to as high as 66 percent. At the upper end of the scale were the heavy-duty laundry detergents and automatic dishwasher products with phosphate content between 28 and 66 percent. Liquid all-purpose cleaners ranged from less than one percent to about 10 percent. Testing generally less than one percent were the liquid detergents for manual dishwashing and fabric softeners. The phosphate level is high in products used specifically for softening and conditioning water for laundry and washing purposes.

Phosphates and farming

The farmer needs phosphates to grow his crops, whether in chemical fertilizers or in natural manure. Once worked into the soil, phosphates are held there so securely that they will not easily wash out. The pollution hazard in agricultural operations usually arises from the animal waste and other organic matter carried off the land by melting snow. Sometimes, too, sizeable areas of fertilized topsoil are washed away not only by snowmelt in the spring but also during heavy storms. This process is known as *sheet erosion*.

These and other causes of phosphate pollution can be controlled by good farming practices. For example, animal wastes should be carefully disposed of or conserved for use as fertilizer—perhaps in a special pit or storage bin. Sheet erosion and excessive runoff can be prevented by contour plowing, proper land drainage or seeding to grass.



It's up to everyone

Checking phosphate input to our lakes and streams is not just a job for farmers, housewives, engineers and detergent manufacturers. It's up to everyone who uses phosphates or other phosphorus compounds in garden fertilizers, pesticides or other materials. It's up to everyone who maintains a house or cottage where no sewers exist for the disposal of wastes—where septic tanks or other facilities must be provided.

Where sewers do exist we must press for adequate sewage treatment, including the removal of phosphates. Since harmless substitutes for detergent phosphates may not be available in Canada in sufficient quantities for some time, we should, in the interests of protecting the quality of our water resources, be prepared to accept detergents that may be less effective. We should support legislation to control the use of phosphates—not only in soaps and detergents, but in other materials as well.

In brief, the control of nutrients—phosphates and nitrates—is a three-pronged effort—

1. A restriction, and later a ban, on the use of phosphates in detergents.
2. The construction of special waste treatment facilities to decrease the quantity of nutrients discharged from municipal sewage.
3. Minimizing, through improved farming practice, the amount of agricultural fertilizers washed from the land.

The success of this effort depends upon public support. Whether we act as individual citizens or as members of an organized group, the responsibility is ours.

why all the fuss about phosphates?

Department of Energy, Mines and Resources Ottawa, Canada

why all the fuss about phosphates?

Department of Energy, Mines and Resources Ottawa, Canada

J. J. Greene, Minister
J. Austin, Deputy Minister

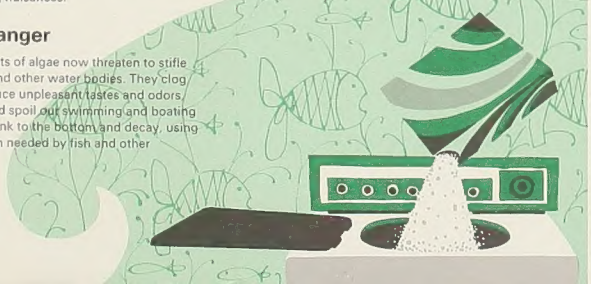
Water pollution begins at home—in the kitchen, the bathroom and the laundry. And one of the most serious causes of pollution is the phosphates that go gurgling down our drains across the country.

Phosphates are found in human and animal wastes, in farm fertilizers and in many industrial wastes. Especially, though, we find them in household detergents. Most of the detergents sold in Canada are used in homes, and domestic sewage is the biggest source of phosphate pollution.

In themselves phosphates are non-toxic. They are compounds of the element phosphorus, which is essential to life. Many of our soils are low in phosphorus and will produce good crops only if they are fertilized with phosphates. But in our waterways the phosphates act as fertilizer for weeds and algae, both serious and growing nuisances.

Green for danger

Slimy green carpets of algae now threaten to stifle many of our lakes and other water bodies. They clog water intakes, produce unpleasant tastes and odors, foul our beaches and spoil our swimming and boating areas. Dead algae sink to the bottom and decay, using up dissolved oxygen needed by fish and other aquatic life.



With the water depleted of oxygen, desirable species of fish disappear. Their place is taken by coarser, less valuable species which need less oxygen. Meanwhile blood worms, sludge worms and other lowly organisms replace higher forms of life on the bottom.

In losing oxygen, moreover, water loses a natural purifying agent. Dissolved oxygen normally allows a lake or river to cleanse itself after receiving considerable quantities of waste. By using up this oxygen, decaying algae therefore aggravate other pollution problems.

Phosphates and nitrates

The excessive fertilization of our waterways, producing an overgrowth of algae, is known as *eutrophication*. Many factors are involved in the eutrophication process, such as availability of carbon dioxide for photosynthesis, abundant sunlight, warm temperatures and clarity of water for light penetration. However, the phosphate nutrient factor is considered to be one of the most critical.

Phosphates and nitrates (the latter also plant nutrients) are both discharged into our lakes and streams through municipal sewage outlets. Because they are used widely in farm fertilizers, some may enter directly from the land. When fertilizers are worked into the top few inches of soil, however, they become fixed and will not, except in cases of severe soil erosion, find their way in significant quantities into lakes and streams.

The atmosphere is another source of nitrates and other nitrogen compounds. These fall with the rain so it is virtually impossible to control them.

To slow the process of eutrophication, therefore, the obvious course is to reduce the volume of phosphates being discharged into our waterways. This can best be done by carefully controlling and restricting the use of phosphates particularly in detergents, and by removing the phosphates by special processes in sewage treatment plants. Neither course of action by itself is enough. We must use both methods of attack.

Phosphate removal

Ordinary sewage treatment is designed essentially to remove organic wastes, which often harbour dangerous disease organisms. It is *not* designed to remove phosphates or nitrates, which in themselves are no hazard to health. Effective phosphate removal requires special treatment facilities.

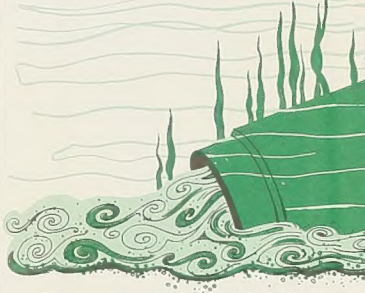
The technology of phosphate removal from municipal sewage is under development and action is being taken by pollution-control agencies of government to move forward from the pilot plant scale of testing to full-scale operational plants.

The construction of suitable plants, however, will take many years and the cost will be high.

How detergents work

In the 1940's, scientists found that combining synthetic soap with a special type of phosphate yielded a washing product far more effective than the earlier synthetic or organic soaps. This discovery led to the development of the phosphate-based detergents which ushered in a bright new age of washday miracles. The advertisements were right : the new detergents got clothes cleaner and whiter than ordinary soap, and worked effectively even in hard water.

Detergents now contain a number of chemicals that do specific jobs—like whitening clothes, protecting washing machines against corrosion, stabilizing suds in top-loading machines and suppressing them in tumbler machines. Some detergents also contain enzymes to break down the proteins in blood, chocolate and other stains. But their main components are the



surfactant (surface-active agent) and the *builder*—usually a phosphate.

The surfactant is the suds-producing ingredient, a superior replacement for soap. Like soap, it increases the wetting action of water by lowering its surface tension. It emulsifies oily substances and holds them in suspension in the water, after prying them loose from fabrics or other materials. Unlike soap, however, it does not precipitate mineral salts to form a curd-like scum.

The phosphate builder softens the wash water, enabling the surfactant to work more effectively. It also makes the water more alkaline, thereby aiding the removal of grease and oil. At the same time, phosphate helps remove soil and other fine particles from cloth fibres. Most important, though, it powerfully reinforces the action of the surfactant, as a loudspeaker amplifies a voice.

What went wrong?

People first became disturbed about detergents when billowing masses of suds appeared in our rivers, lakes and sewage disposal plants. This happened because the surfactant—the sudsing ingredient—would not break down under sewage treatment or other bacterial action. In other words, it was not *biodegradable*.

The surfactant then commonly used was a petroleum industry product, known to chemists as *alkyl benzene sulphonate* or *ABS*. In the early 1960's, to end the